Canada Mortgage and Housing Corporation
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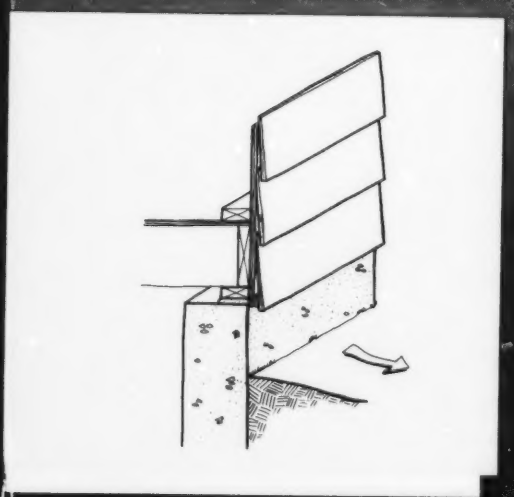
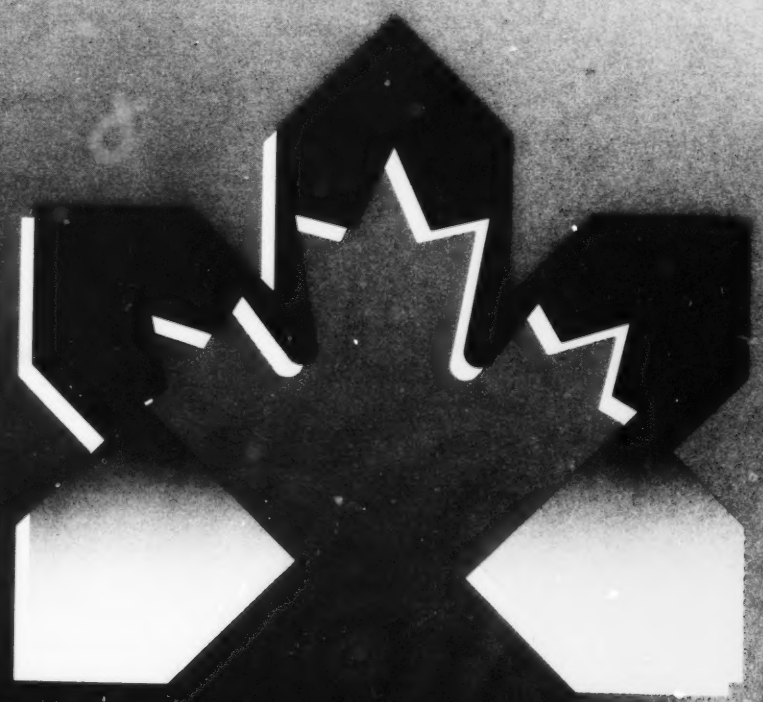
BUILDERS' SERIES

Siding Problems





CMHC Helping to house Canadians

Siding Problems

The material for this publication was developed in consultation with the Canadian Home Builders' Association for a series of builders' workshops held across the country.

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The information in this publication represents current research results available to CMHC, and has been reviewed by a wide spectrum of the housing industry. The Corporation, however, assumes no liability for any damage, injury or expense that may be incurred or suffered as a result of the use of this publication.

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Introduction

This booklet, *Siding Problems*, is written to give Canadian home builders the facts about siding problems and suggest ways to avoid them.

Information for this guide was compiled from many sources. Particular acknowledgement goes to the National Research Council and Canada Mortgage and Housing Corporation for their publications on this subject, and to the Canadian Home Builders' Association, for its assistance.

Siding problems occur when one or more of the following situations exist:

- the wall is leaking
- the siding materials are deteriorating
- the siding materials are moving or shifting to an unacceptable extent
- the shape of the material is changing
- the siding has an unsightly appearance.

This booklet provides the builder with a diagnosis of each common siding problem. Causes and solutions follow in each case.

Controlling Moisture Problems

Water can cause severe problems with building materials. Rainwater penetrating the siding and condensation forming inside the wall cavity are two problems that occur with all siding types. According to the National Research Council publication *Water and Building Materials* moisture can cause dimensional change, corrosion, decay, blistering, efflorescence, leaching, freezing and poor appearance.

The builder can prevent most of these problems by using the rain-screen principle and the air-barrier system. The builder can also take precautions when selecting and applying sheathing paper, door and window flashing and caulking.

Rain Penetration

Rain penetrates siding when water is present, when openings are available, and when there are sufficient forces to move the water inward.

Builders can do little to prevent rain water from reaching the wall surface. Despite wider roof overhangs and cantilevered projections, walls continue to get wet during rain storms with driving winds.

Blocking unnecessary openings with caulking eliminates the problem temporarily, but sealants age and building elements can shift. Eventually, cracks form and water enters.

The answer lies in controlling the forces that move water inwards. According to NRC's publication *Rain Penetration and Its Control*, water entry from capillary suction, gravity, and air pressure differences can be controlled by "the introduction of an air space in the joint or wall: but the air pressure must always be equal to that on the wall face. This can be accomplished by allowing sufficient free area of opening to the exterior to allow the wind pressure to maintain equalization. When the air pressures both outside and inside a wetted plane are equal, there is no air pressure difference to move the water inward." (CBD 40, p. 3)

The Rain-Screen Wall

The rain-screen wall consists of an outer layer of siding or cladding, an airspace, and an inner wall. The airspace is vented to the outside. When wind blows against the wall, it passes through the vents to the contained airspace and raises the air pressure inside until it is the same as that of the exterior. There is now no difference in pressure to drive the water past the airspace (fig. 1).

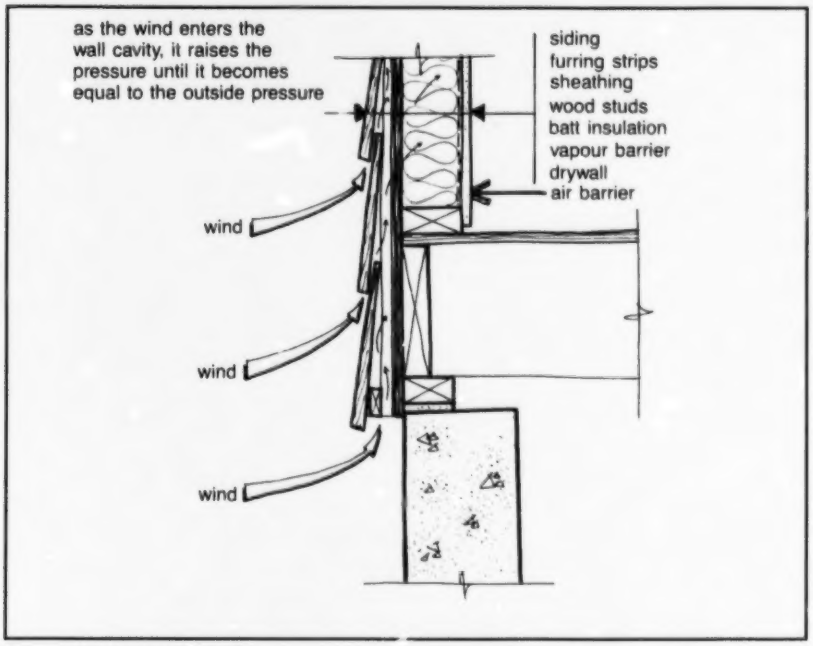


Fig. 1. A rain-screen wall.

The rain-screen wall functions well if the builder observes a number of precautions. The CMHC publication *Moisture Problems* describes them in detail. They include:

- making the wall space airtight at its inner face – if it is not, the air pressure in the cavity will not equalize with the exterior air pressure, and the wind will drive water through the wall;
- containing the air space at the corners and top of the wall, enabling the pressure in the airspace to build up and become equal to that of the exterior (fig. 2).
- providing openings on the face of the exterior wall that permit wind to penetrate the air space (fig. 2).
- providing a flashing at the sill, as a way for water to escape from the air space (fig. 3).

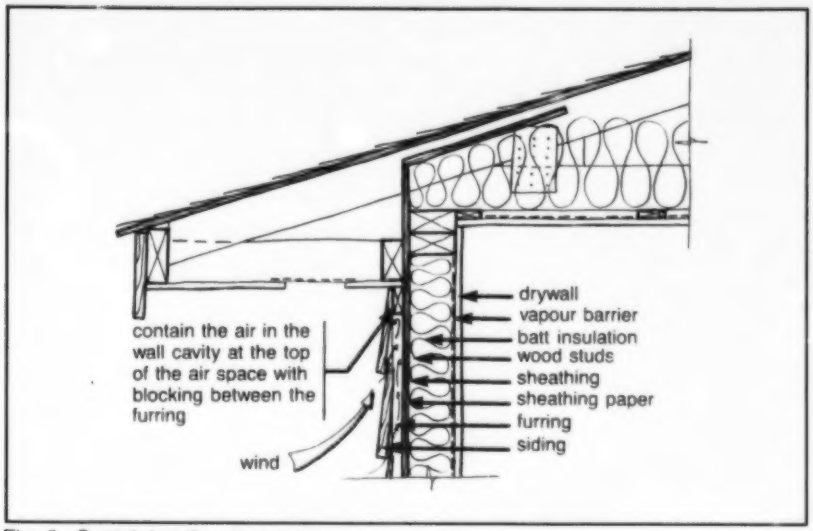


Fig. 2. Containing the air space.

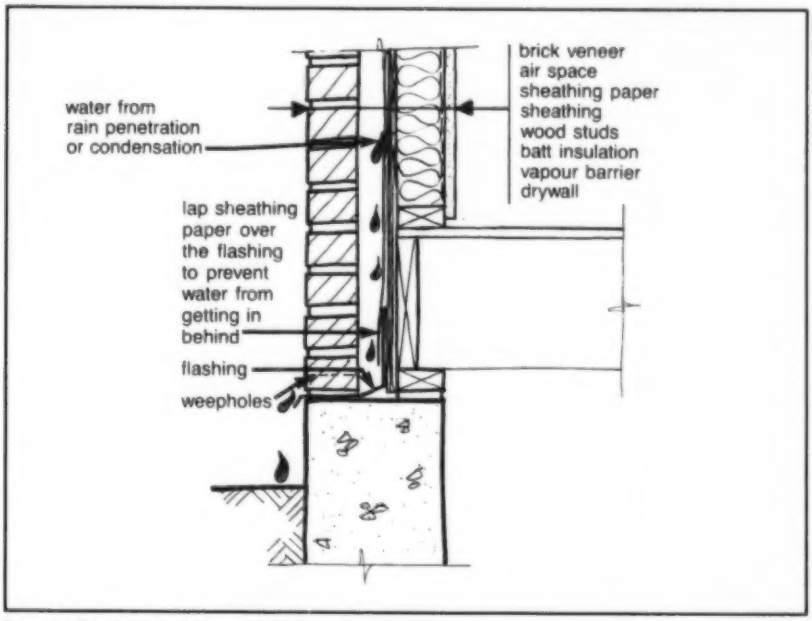


Fig. 3. Provide flashing at the sill.

Concealed Condensation

Water created by condensation inside the exterior wall causes rapid deterioration of certain sidings.

When warm air leaks into the exterior wall assembly, the amount of water vapour it retains reduces as the temperature drops. When the temperature is sufficiently low, the air becomes saturated and water vapour condenses in the form of a liquid or frost. The temperature at which this occurs is called the dew point.

In the winter or in cooler seasons, moist warm air can leak into the exterior wall cavity because of the pressure differential between the interior and the exterior. As it cools and reaches a surface which has a temperature lower than its dew point, the water vapour in the air condenses. This condensation is often hidden and only becomes evident after serious deterioration has set in.

The Air-Barrier System

Builders can control the movement of moist warm air from the interior through the exterior walls by establishing an airtight plane or barrier that blocks the flow (fig. 4).

The air barrier system will perform better if it is continuous, strong and rigid, resists the flow of air, and is durable and easy to maintain.

Ideally, builders should locate the air barrier on the warm side of the wall, where it is easier to locate and repair and less exposed to the harsh climate.

Refer to the CMHC publication *Moisture Problems* for further information on air barriers.

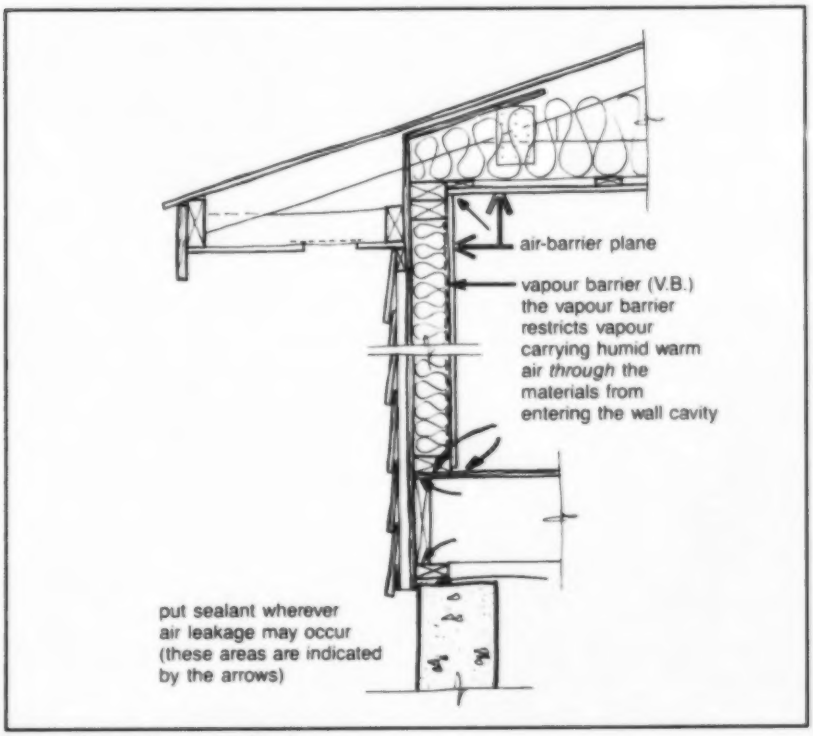

air-barrier plane
vapour barrier (V.B.) the vapour barrier restricts vapour carrying humid warm air *through* the materials from entering the wall cavity
put sealant wherever air leakage may occur (these areas are indicated by the arrows)

Fig. 4. Establish an airtight plane.

Problems Common to All Sidings

Problem

Water penetration through the siding.

Water penetrates all sidings. In wood and hardboard sidings, it causes rotting, peeling paint, water stains, mould and mildew, damaged insulation, warping and buckling, and severe damage to the wall structure. In vinyl and metal sidings, water penetration soaks insulation and deteriorates framing members and interior finishes.

Causes

Lack of a rain-screen wall.

Incorrect application of sheathing paper.

Solutions

Lack of a rain-screen wall

- Use a rain-screen wall to reduce the pressure difference between the exterior (wind) and the interior of the wall and therefore reduce water moving into the wall cavity. Refer to the CMHC publication *Moisture Problems* for details on how to construct rain-screen walls.

Incorrect application of wall sheathing paper

- Make sure that wall sheathing paper is properly applied. The absence or improper installation allows water that has penetrated the exterior siding to move into the wall cavity. Wall sheathing paper acts as a secondary moisture barrier behind the siding. It should be moisture-resistant but not vapour-resistant, so that water vapour can pass through the wall to the exterior. CMHC's *Canadian Wood-Frame House Contruction* suggests the following:
  - use one layer of sheathing paper over wall sheathing
  - lap joints 100 mm (4")
  - return edges around framing members at openings and staple them to the frame.

Problem

Premature deterioration.

Sidings deteriorate prematurely mainly because of moisture.

Causes

Rain penetration.

Condensation from air leakage.

Solutions

Rain penetration

- Rain water enters sidings by momentum, gravity, capillary suction or air pressure differential across the wall section. Once trapped, it promotes the growth of fungi on or behind the siding which destroys wood cells, and promotes corrosion of metal sidings and fasteners. See the previous problem, "Water Penetration," for specific ways to prevent rain penetration. See also CMHC's publication *Moisture Problems*.

Condensation from air leakage

- Prevent the damage caused by condensation, which is created when warm humid air leaks into the exterior wall and condenses on the back face of sidings. Condensation results in ideal conditions for the growth of fungi when moisture and oxygen are present and the air temperature is between 20 and 30°C (68 and 86°F). The growth of fungi destroys wood fibres and promotes corrosion of metal sidings and fasteners. Use an air-barrier system to prevent the leakage of moist indoor air into the wall. See *Moisture Problems* for detailed techniques.

Problem

Siding deformation or displacement.

Persistent deformation will weaken sidings and provide openings through which water can penetrate.

Cause

Direct installation over semi-rigid insulation.

Solution

Direct installation over semi-rigid insulation

- Provide a stable backing for sidings. Siding applied directly over semi-rigid insulation may deform and appear wavy because the insulation compresses when siding is installed too tightly. Use wall sheathing, strapping or furring for wood and hardboard sidings. Use a backing that provides continuous support for vinyl and light metal sidings. Heavier metals resist bending and may be spanned over furring strips. It is important to follow the manufacturer's instructions closely.

Wood and Hardboard Siding Problems

Problem

Water penetration through the siding.

Water penetrates wood and hardboard siding and causes wood rot, peeling paint, water stains, mildew, damaged insulation, warped and buckled lumber, and severe damage to the wall structure. See also "Problems Common to All Sidings."

Causes

The presence of gaps in the siding.

Poor drainage of wall elements.

No drips at sills or joints.

Incorrect joint construction.

Solutions

The presence of gaps in the siding

- Prevent gaps in the siding which permit the movement of water into and, in some cases, through the siding into the wall cavity, by the following means:
  - caulk joints at the corners, and at window and door openings, except for those ventilation gaps used as part of the rain-screen wall (fig. 5).
  - for wood – use lumber free from splits, knot holes and loose knots
  - to prevent future shrinkage and cracking, use siding material that has a moisture content about the same as it will have when it is in place, namely, less than 19 percent.

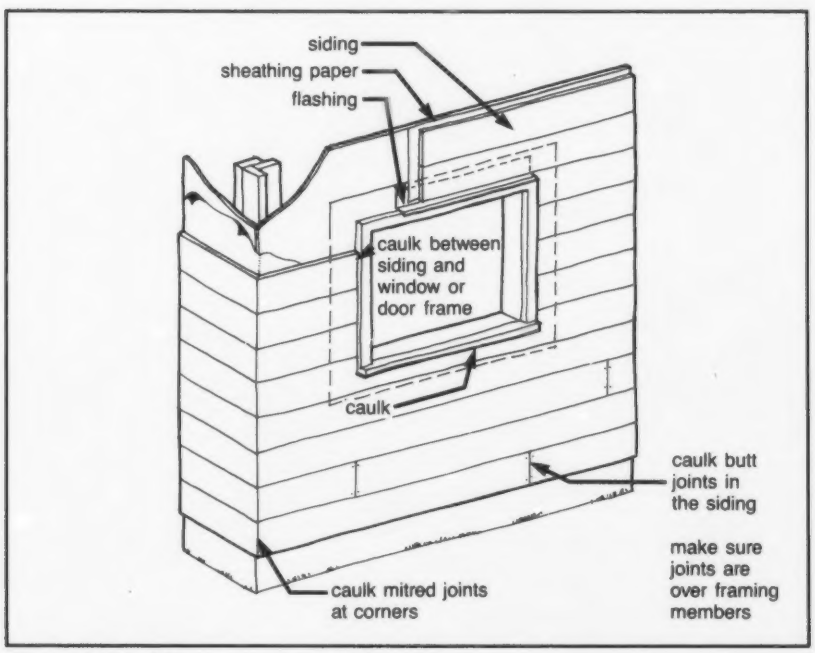


Fig. 5. Caulk joints.

Poor drainage of wall elements

- Take precautions against the force of gravity which can move rain water inward toward the wall cavity:
  - install flashing at the head of door and window frames and where two wall materials meet (fig. 6).
  - provide adequate outward slopes to window and door sills.

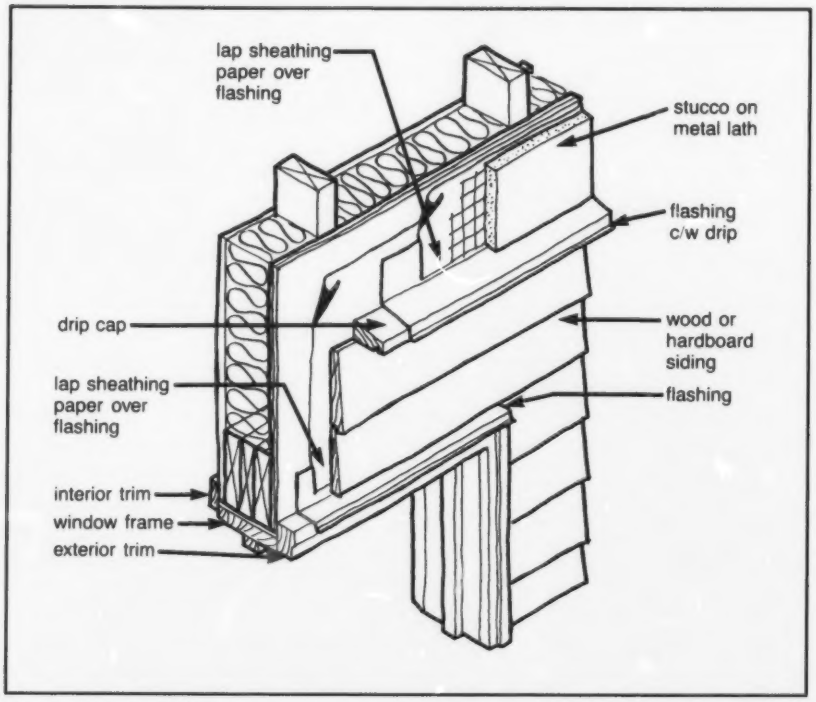


Fig. 6. Install flashing.

No drips at sills or joints

- Provide saw kerfs or formed chases to stop capillary suction action that can draw rainwater up the underside of window and door sills and into the siding. Create 2.5 mm (1/10") gaps in the lap joint of horizontal siding. The gap can be achieved with round-headed nails or wedges (fig. 7).

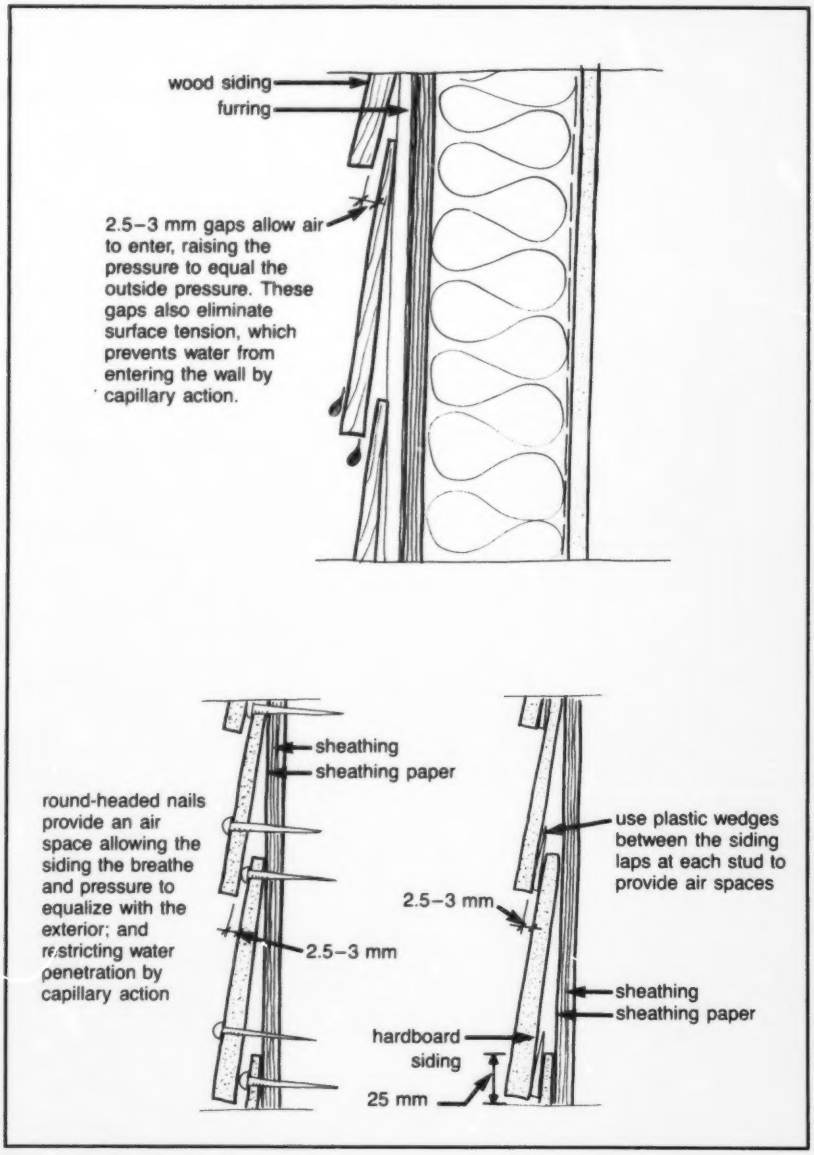

wood siding
furring
2.5–3 mm gaps allow air to enter, raising the pressure to equal the outside pressure. These gaps also eliminate surface tension, which prevents water from entering the wall by capillary action.
sheathing
sheathing paper
round-headed nails provide an air space allowing the siding the breathe and pressure to equalize with the exterior; and restricting water penetration by capillary action
2.5–3 mm
use plastic wedges between the siding laps at each stud to provide air spaces
2.5–3 mm
sheathing
sheathing paper
hardboard siding
25 mm

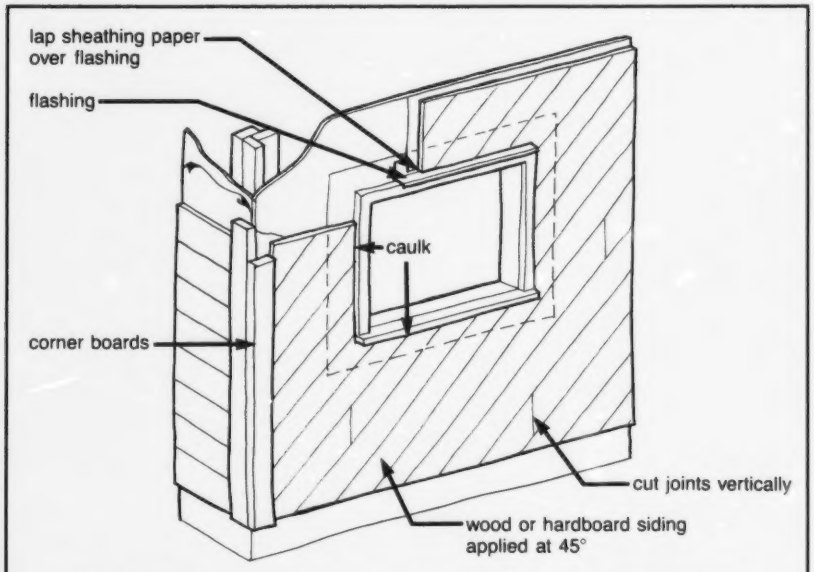
Fig. 7. Create gaps in lap joints.

Incorrect joint construction

- To help drain water away, and stop the flow of water through the joints of wood and hardboard siding, take the following precautions:
  - cut the butt joints of diagonally installed siding so that the joint is vertical (fig. 8)
  - stagger butt joints in alternate siding courses as much as possible
  - mitre siding joints at outside corners where corner boards are not used.

for hardboard

- seal all butt joints with caulking when joint moulds are not used, and provide a 5 mm (¼") space to accommodate any expansion (fig. 9)



Note: For wood, mitred joints are better than butt joints. For hardboard joints, accessory pieces are provided by the manufacturer for finishing joints.

Fig. 8. For diagonally applied siding, make joints vertical.

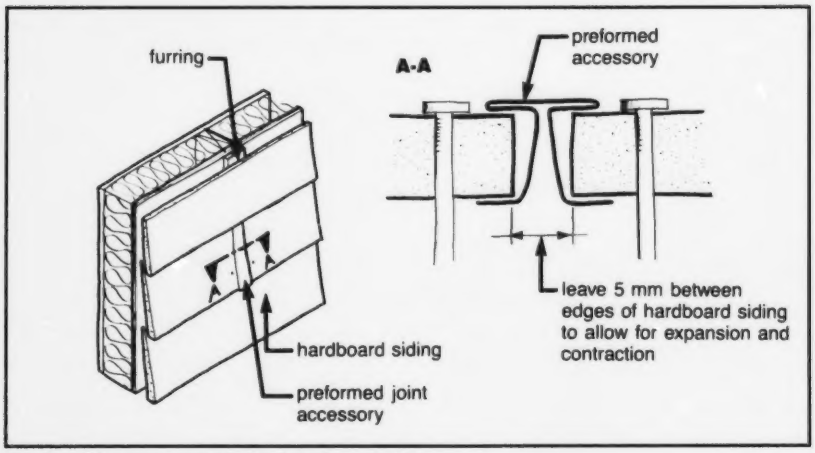


Fig. 9. Joint accessories for hardboard siding.

- ensure that all joints are over framing members
- provide a 3 mm (⅛") space at the butt joint between the siding and window/door trim and caulk this joint (fig. 10)
- where premoulded corner pieces are used with hardboard lap siding, follow the manufacturer's instructions for proper installation (fig. 11).

for wood

- lap horizontal bevel siding at least 25 mm (1")

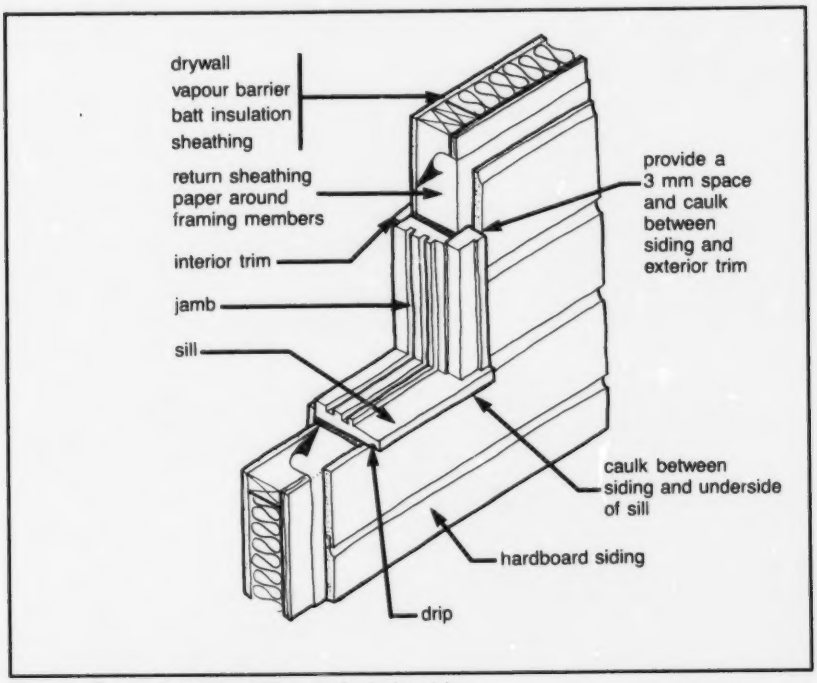


Fig. 10. Space between siding and window trim.

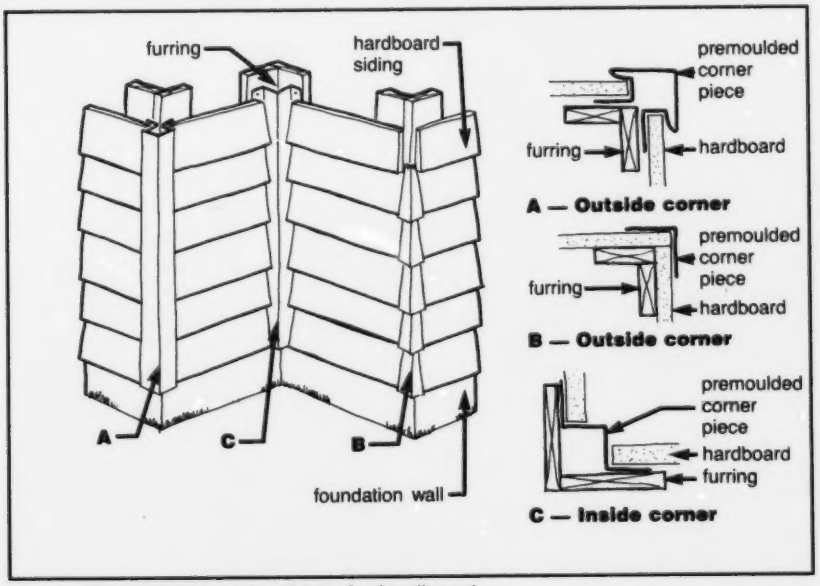


Fig. 11. Premoulded corner pieces for hardboard.

Problem

Premature deterioration.

Wood siding deteriorates prematurely because of moisture-induced wood rot.

Causes

Rain penetration. (See "Problems Common to All Sidings.")

Condensation from vapour diffusion.

Insufficient clearance at grade and at roof junction.

Solutions

Condensation from vapour diffusion

- Prevent the damage caused by condensation. When humid indoor air leaks into the exterior wall and condenses on the back face of wood and hardboard siding, it creates ideal conditions for the growth of fungi which attack wood cells when moisture and oxygen are present and the air temperature is between 20° and 30°C (68 and 86°F). Take the following precautions (see also "Problems Common to All Sidings"):
  - use seasoned, dry framing and sheathing lumber to prevent the transfer of moisture to the siding after construction
  - reduce vapour diffusion through the wall by providing a vapour barrier (such as vapour-barrier paint, or two coats of oil-based paint) on the inside surface of the exterior walls or ceiling, and install a vapour barrier (such as polyethylene) on the warm side of the insulation when the exterior sheathing has a low vapour permeability
  - use a single layer of 15 lb wall sheathing paper between the sheathing and the siding, lapped 100 mm (4") around the edges
  - advise the homeowner to avoid humidifying the house, to increase ventilation, and to use a dehumidifier when necessary.

Insufficient clearance at grade and other junctions

- Prevent rot by extending the siding below the blocking or flashing – but keep it at least 200 mm (8") above grade (fig. 12) or 50 mm (2") above the abutting roof junction (fig. 13). Wood and hardboard siding that rests on grade or is too close to grade may not allow surface wall water to drain properly. As a result, water can enter vertical siding through the ends, or horizontal siding through the edge by capillary action. This water causes wood rot.

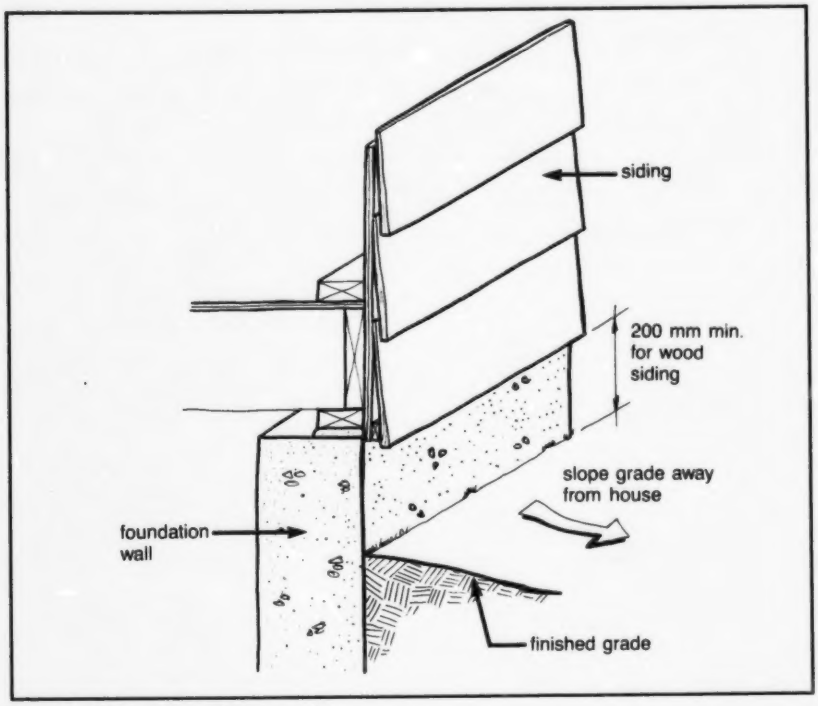


Fig. 12. Keep siding above grade.

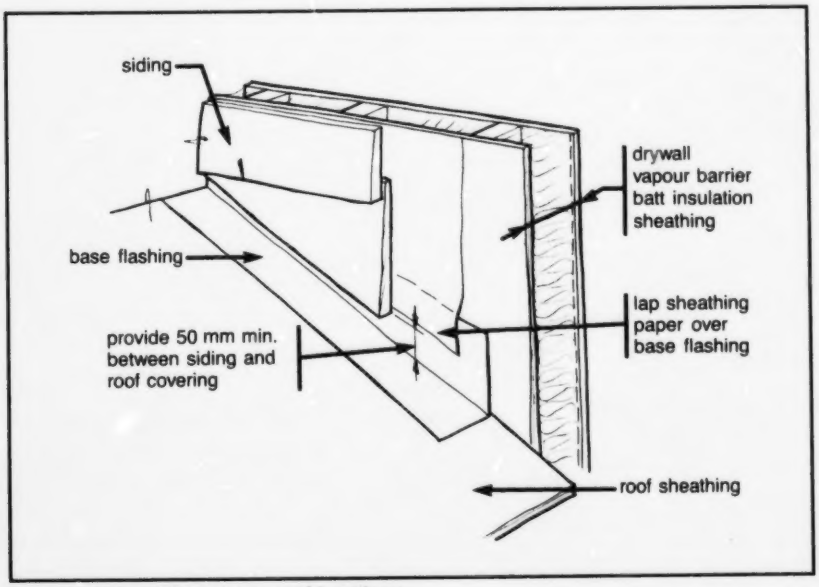


Fig. 13. Keep siding above roof junctions.

Problem

Siding deformation or displacement.

Persistent deformation will weaken the siding and provide openings through which water can penetrate.

Cause

Moisture penetration.

Solution

Moisture penetration

- Moisture that penetrates wood and hardboard siding by means of rain or condensation can cause warping and buckling. Refer to earlier sections of this guide for solutions to controlling moisture.

Problem

Poor appearance.

The attractiveness of wood and hardboard siding is diminished by the deterioration of the finish and by the deformation of the material.

Causes

Moisture penetration.

Poor quality materials.

Green lumber.

Solutions

Moisture penetration

- Prevent the presence of moisture caused by rain penetration or condensation, which warps and twists siding materials. It will also create external stains and mildew, and cause paint to peel. Increase the drying potential of the siding by providing increased drainage, more air circulation on the back side (refer to rain-screen principle), and capillary breaks on the lower edges. Install siding over furring strips. See earlier sections of this publication for information on preventing moisture related problems.

For wood siding:

Poor quality materials

- Avoid the use of inferior-grade wood siding and siding that has been damaged on the site. Use clear lumber, free from checks, cupping, splits and knot holes. To use other than good quality lumber is a false economy.

Green lumber

- Do not use green lumber, which will split, cup, check, warp and shrink as it drys. Use material that has a moisture content not greater than 19 percent (fig. 14).

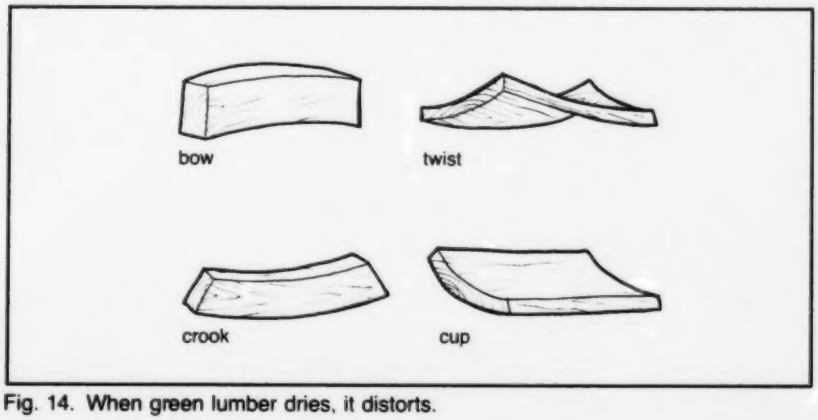


Fig. 14. When green lumber dries, it distorts.

Vinyl and Metal Siding Problems

Problem

Water penetration.

Water penetrates through the joints of vinyl and metal siding, soaking insulation, and deteriorating framing members and interior finishes. See also "Problems Common to All Siding."

Causes

Incorrect joint detailing between siding strips.

Incorrect detailing at corners.

Incorrect detailing around windows and doors.

Solutions

Improper joint detailing between siding strips

- Drain water away, and prevent the flow of water through the joints of vinyl and metal siding, by taking the following precautions:
  - follow the manufacturer's instructions for installing the siding
  - when siding is installed diagonally, cut the joints perpendicular to the ground and overlap the lower strip with the upper strip (fig. 15)
  - ensure that all joints in alternate courses are staggered by at least 900 mm (36").

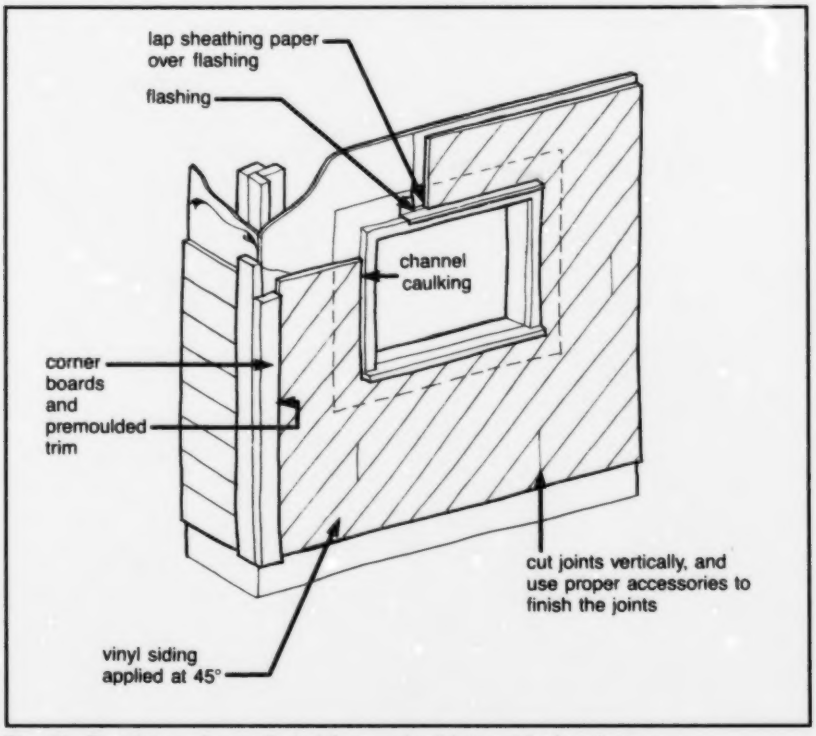

lap sheathing paper over flashing
flashing
channel caulking
corner boards and premoulded trim
cut joints vertically, and use proper accessories to finish the joints
vinyl siding applied at 45°

Fig. 15. For diagonally applied siding, make joints vertical and use proper accessories to finish them.

See fig. 16 for some of the common details suggested for most metal and vinyl products.

Incorrect joint detailing at corners

- Ensure that corner recesses drain water away from the interior by taking the following precautions:
  - use only premoulded corner piece accessories on every outside corner (see fig. 17 for typical corner details suggested by manufacturers)
  - follow the manufacturers' installation requirements closely.

Incorrect detailing around windows and doors

- Do not leave out flashing, which is still required at the head and cannot be left out in spite of manufacturers' accessories that help make windows and doors watertight. See fig. 18, which illustrates the details at window/door heads, jambs and under window sills.

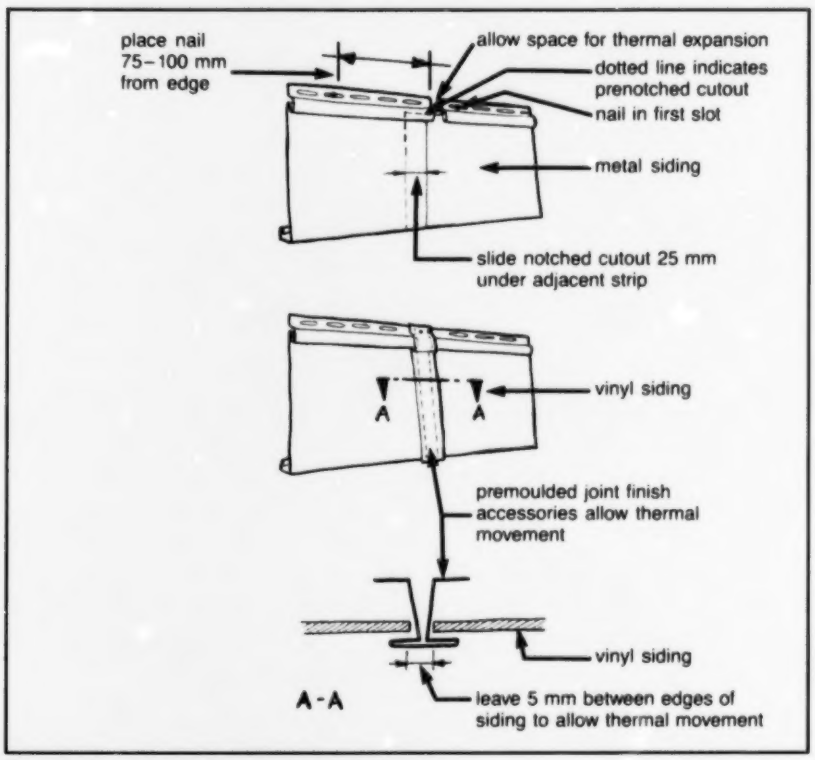


Fig. 16. Joint details for metal and vinyl siding.

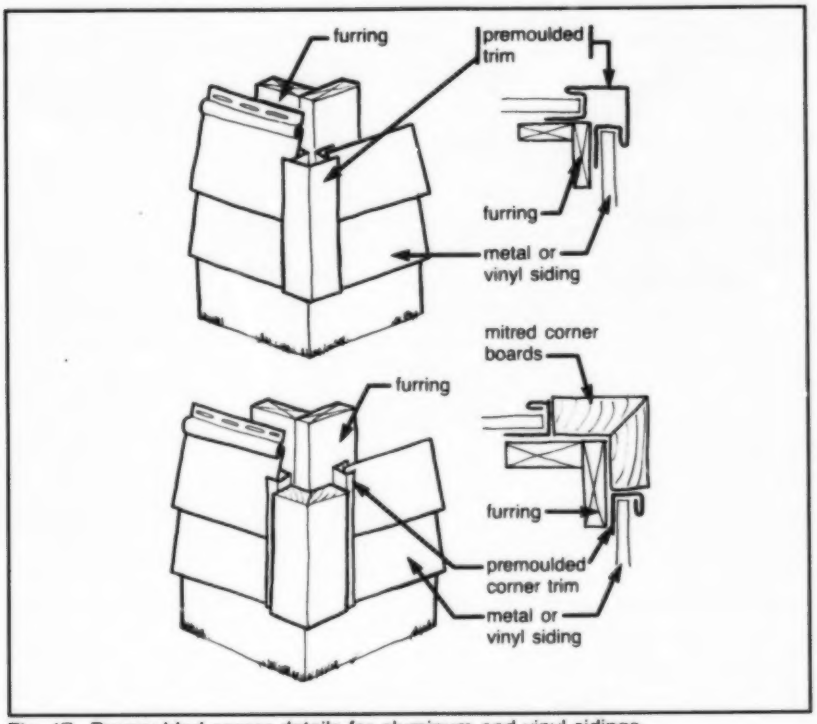


Fig. 17. Premoulded corner details for aluminum and vinyl sidings.

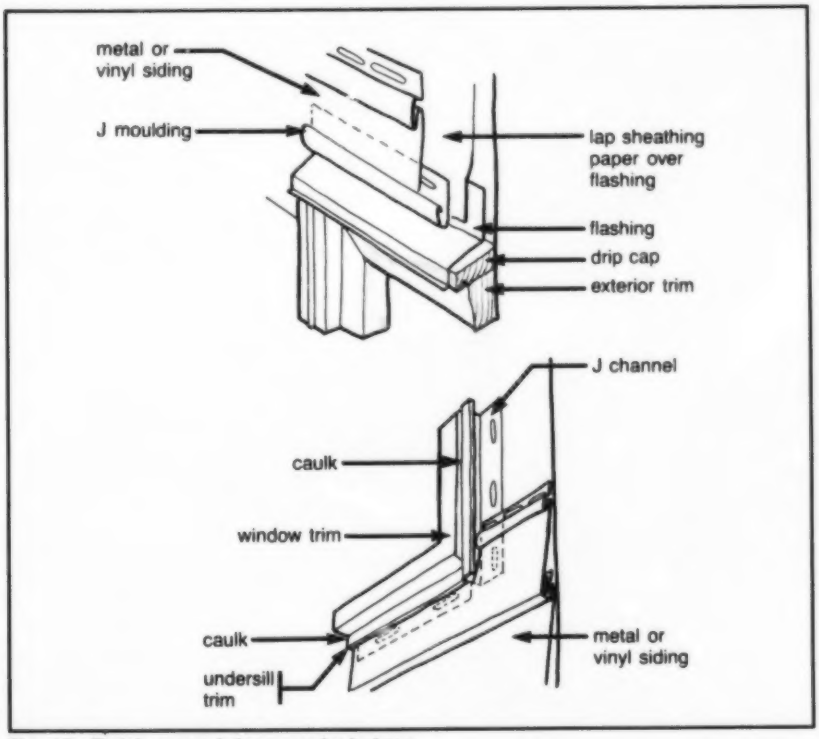


Fig. 18. Finish around doors and windows.

Problem

Metal and vinyl siding deformation or displacement.

Deformed or displaced siding can break down and provide openings through which water will penetrate. See also "Problems Common to All Siding."

Cause

Thermal expansion contraction.

Solutions

Thermal expansion contraction

- Make sure that the method of application does not restrict thermal movement. Expansion and contraction because of changes in temperature cause the most problems with vinyl and metal siding. To accommodate this movement follow these practices:
  - apply the siding according to manufacturer's instructions
  - use the nail slots provided in the siding and make sure that nails are set in the centre of the slots (fig. 19)
  - do not nail through the material
  - nailing should not be less than 400–450 mm (16–18") o.c.
  - do not over-tighten nails (this may restrict movement as well as cause waves in the siding); allow approximately 0.7 mm (1/32") between the nail head and siding (fig. 20); siding is "hung," not nailed tightly
  - where siding butts into a window or door frame provide a space, as recommended by the manufacturer – most products use "j" channels, which cover this space (fig. 21)
  - to make joints less noticeable, lap them away from streets and entrances
  - for vinyl siding, provide a suitable joint between individual pieces — some vinyl siding products use lap joints, whereas others provide accessories (see fig. 16).

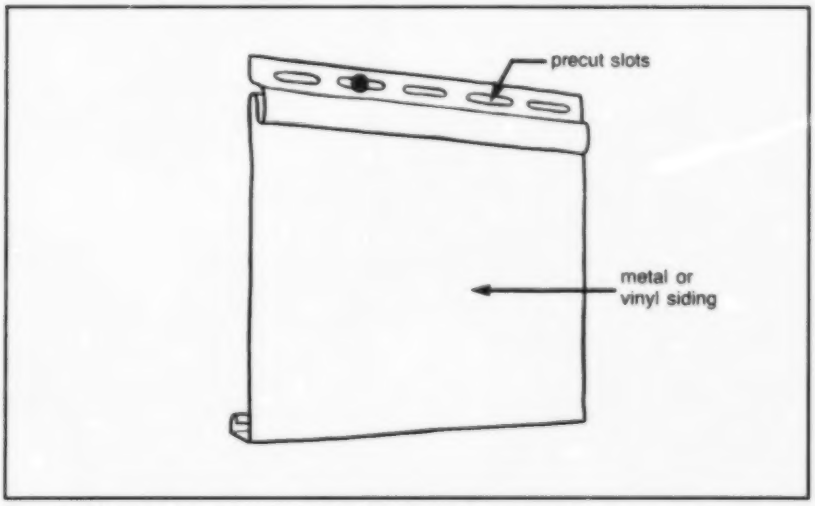


Fig. 19. Nail in centre of slot to allow for thermal movement.

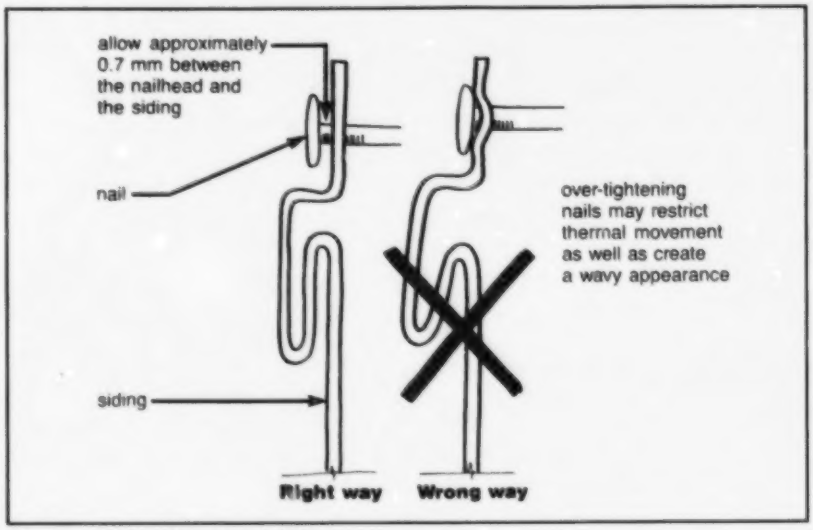


Fig. 20. Avoid nailing too tightly.

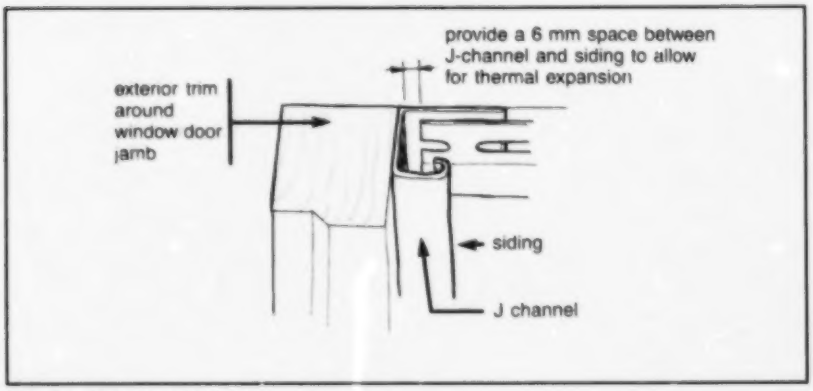


Fig. 21. Exterior trim joint.

Additional Reading

Source	Publication
Canada Mortgage and Housing Corporation 682 Montreal Road Ottawa, Ontario K1A 0P7 (613) 748-2000	*Canadian Wood-Frame House Construction*, 1988 NHA 5031 *Moisture Problems*, 1988 NHA 6010
Council of Forest Industries of B.C. 1500/1055 West Hastings Street, Vancouver, British Columbia V6E 2H1	*Western Red Cedar Shingles and Shakes: A Handbook of Good Practice*, 1987 *The Western Red Cedar Handbook*, 1987 *Roof and Wall Shingling Made Easy*, 1987
National Research Council of Canada Institute for Research in Construction Publications Section Ottawa, Ontario K1A 0R6 (613) 993-2463	*The Difference Between a Vapour Barrier and an Air Barrier*, 1985 BPN 54 *Humidity, Condensation, Ventilation in Houses*, 1984 NRCC 23293 *Rain Penetration and Its Control*, 1984 CBD 40 *Moisture Problems in Houses*, 1984 CBD 231

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